

## **YAKIMA RIVER BASIN ENHANCEMENT PROJECT REVIEW SUMMARY OF PRESENTATIONS**

On February 4 and 5, 1992, participants, consultants, and people interested in the Yakima River Basin Enhancement Project met to present, hear, and discuss results of studies conducted for Phase I of the project. Abstracts of the presentations were provided at the conference. This summary synthesizes the abstracts and the speakers' main points.

### **THE PROGRAM IN GENERAL**

#### **TOM CLUNE, Project Manager, Bonneville Power Administration History and Organization**

The Yakima River flows 200 miles in Washington State, from its headwaters at Keechelus Lake near Snoqualmie Pass north of Mount Rainier, to the Columbia River near the Tri Cities. The Yakima and its 1700 miles of tributaries drain about 6,000 square miles of forest, farmland, and sagebrush desert.

The Yakima Program began in 1982 with the adoption of the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program. Historically, between 500,000 and 900,000 adult salmon and steelhead returned to the Yakima River each year. Although runs were down to 1-2,000 by the early 1980's, the Council believes the Yakima Basin has enough good habitat left to handle much larger numbers. Today, 7-10,000 fish are returning, and more are expected in the future.

The improvements have been made through a large project team representing a diverse range of interests. The "Yakima Enhancement Project" diagram lists the participants and shows the main elements of the project.

Each of the four main elements has a specific purpose. **Water enhancement** measures make agricultural water use more efficient and improve instream flows for fish and wildlife. **Passage** measures include construction of ladders and screens to improve salmon and steelhead migration in the basin. **Yakima Fisheries Project** is a complex scientific program to test the principles of supplementation, maintain genetic resources, and increase harvest opportunities. **Habitat** measures seek to improve the natural production potential of the basin.

#### **ROLLAND SCHMITTEN, Regional Director, National Marine Fisheries Service**

##### **Project Performance So Far**

It is important to assess where you are and where you're going in any project or program. So it is probably appropriate to evaluate aspects of the Yakima project at this time. But first, a little history.

The genesis of this project came in 1980 with the passage of the Pacific Northwest Electric Power Planning and Conservation Act, which, among other goals, was to bring equity between fish and power. Under the Act, the Northwest Power Planning Council was required to develop a program to protect, mitigate, and enhance Columbia River fish and wildlife and related habitat.

In 1982, when the Council approved the Yakima project, they also approved the Basin's first outplanting facility, to supplement natural fish runs. In light of the Endangered Species Act petitions today, this action was foresightful. The Council also required fish passage facilities at irrigation dams in the Yakima Basin.

This led in 1987 to the Master Plan for the Yakima Basin Enhancement Project. Its purposes were to:

- 1) construct, operate, and maintain facilities to rebuild naturally spawning salmon and steelhead stocks and to reintroduce stocks historically present in the Basin;
- 2) conduct research on supplementation to integrate standard hatchery propagation with natural runs; and
- 3) improve Yakima River habitat.

But the main theme was to have the project be a prototype on the use of supplementation.

At some risk, I give the project the following grades.

I would give **problem identification** an "A," because the project recognized early the importance of natural runs and how supplementation might support them. Also, the project was designed to meet domestic and international legal mandates under *U.S. v. Oregon* and the new Pacific Salmon Treaty. And the project quickly got beyond the questions of whether or when to intervene in the ecosystem to the question of *how* to intervene.

The **action plan** I would give a "B+." The early focus on passage improvements, begun in 1982, was the right start. Without passage, there is no reason to enhance. Now the major passage problems are corrected and secondary screening issues are being worked on. The "B+" also applies to the high priority given to maintaining genetic integrity. But the project is slowed by the Northwest Power Planning Council's justifiable request for measures of progress. Biological improvements are hard to measure, especially in the short term. It may be 12 to 16 years before fisheries biologists know if their call is correct. If it's wrong, we'll have a long way to go before we see changes.

I would give **plan implementation** a "C-." The project needs to move out of the planning mode and apply the principles of adaptive management.

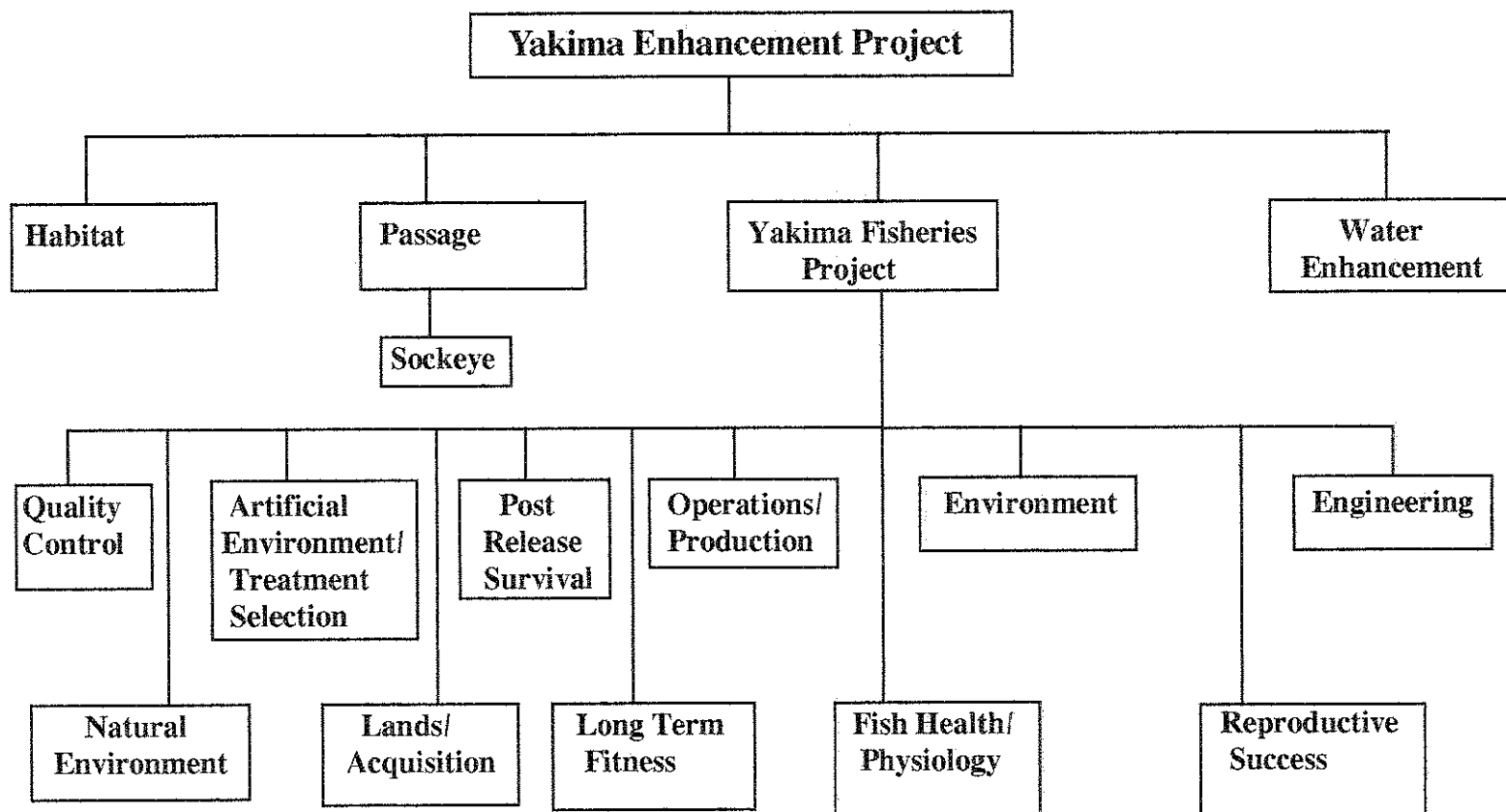
How does ESA fit into this project? The petitions help focus attention on wild stock concerns, hatchery practices related to wild stocks, and water user needs and capabilities. But ESA is no way to run a business. It abrogates managers' responsibilities and represents a piecemeal approach to solving problems when what is needed is a holistic, basin-wide solution. While the region is focusing on a few fish under petition and not looking at system-wide needs, other runs continue to decline.

With few exceptions, wild fish needs are habitat needs. Habitat needs are integral to the Yakima plan.

I support a holistic, regional solution. Recovery requires a regional solution, which is more likely to be funded than one imposed unilaterally by NMFS. It requires all users to participate, and it needs support by a regional constituency. It must apply to California, Oregon, and Washington. A regional approach also is likely to reduce forthcoming litigation. The process to define it must be proactive and interactive, taking lessons from the Hatfield Salmon Summit, Power Council plans, and the Yakima Fishery Project. But it can't be just another study. Time is of the essence. We need to move to an action plan. And supplementation--which is beyond being an experimental process--will be the key to a regional program.

We must meet recovery goals, which are harvestable numbers of fish, not museum pieces. The solutions are not solely one user group's problem--harvest is an integral part of recovery but not the sole part.

There will always be some biological uncertainty, but after nine years, we cannot wait for exact answers.



#### Participants

##### Federal

Bonneville Power Administration  
Bureau of Reclamation  
Fish and Wildlife Service  
Forest Service  
National Marine Fisheries Service

##### Washington State

Department of Ecology  
Department of Fisheries  
Department of Wildlife

##### Other

Northwest Power Planning Council  
Yakima Indian Nation  
Irrigation districts  
Consultants  
Local governments  
Universities  
U.S. Congressmen & Senators

## ROY SAMPSEL, Sampsel Consulting Services Central Policies

The following are key policies of the Yakima project.

- **Adaptive Management.** The project recognizes that some scientific questions may remain unanswered when action is required. The team takes that as a challenge and goes ahead anyway. For example, we were probably too ambitious in the early planning for this project, which was originally the Yakima/Klickitat Production Project. But we weren't afraid to say later that we didn't know enough about the Klickitat portion of the project to move forward right now. So now we have the Yakima Fisheries Project, which we're evaluating in an environmental impact statement.

Does it bother me that we don't know all the answers? As Rollie suggested, you're in the wrong business if that worries you.

With adaptive management, we need flexibility in strategy. Some failure of strategy is acceptable. There's nothing wrong with being wrong. Mistakes were made in the last 30-40 years. But perhaps the biggest was not having the means to monitor and evaluate projects and make course changes. We were unwilling or unable to institutionalize the learning process. Failure is not in the making of mistakes, but in the inability or reluctance to recognize and correct them.

- **The Best Science Guides Decisions.** There may be debate about what the best science is, but the debate is not the product. Decisions may be made without all the answers. The opportunity we have now is to use the vast resources at our disposal--people, dollars, the commitment of the people of the region--to figure out how to manage the Columbia River's resources. If we can't do it here, with the resources we have, wouldn't it be a shame?

- **Teamwork.** Freeing team members from their institutions' old policies and procedures broke down old conflicts and mistrusts. It also allowed the team to be creative and to challenge their own institutions. There wasn't always consensus and agreement, but the commitment to work together never changed--so people worked through the decision process on tough issues.

- **Institutionalized Learning.** We're committed to evaluate the project and learn from our mistakes. We want to hear during this conference about refinements that need to be made. We want the session to be more than "come and listen"; we want it to be "come and participate," either on a technical or a policy basis. Open discussion and participation in scientific conclusions and solutions is important for two reasons: 1) what happens in the Yakima Basin has ramifications for the entire Columbia Basin; and 2) active participation acts as a check on managers and decisionmakers during all phases from planning to implementation.

Critical review of the EIS is also important. The EIS should be available in late summer of 1992. It lays out alternative approaches and sets the framework for the final decision on this project. Your participation in review of this document and in other processes is key to our collective responsibility to learn.

The single biggest impediment to the Yakima Project meeting its objectives was uncertainty in the process. We could have moved faster if we had known process requirements. With perfect hindsight, we can say that the team should have started an EIS at the beginning of the project. We lost two years. It is sad because we would already be finished now with part of the process and could have learned from it.

Other impediments were:

- Everyone talked about the principle of adaptive management, but nobody truly believed it. It is easier to plan 14 options than to start one, knowing it could change down the road.

- Creativity--doing things differently--takes more time than the standard cookie cutter hatchery approach.

What happens if this project doesn't work? I'll buy the sledgehammer. But I want to ensure that we have explored all alternatives, and that we take time to see what is happening. But if we have erred, we *have* to stop. There's nothing wrong with using those raceways for tulip patches.

**RANDY HARDY, Administrator, Bonneville Power Administration  
BPA's View**

**BPA is committed to the Yakima Project.** We recognize that compliance with the National Environmental Policy Act has caused some delays. We will be looking at whether our internal resources are arrayed efficiently to avoid further delays.

**BPA will take risks with supplementation.** We don't need all the data before deciding to spend money. We may learn from our mistakes as much as from our successes.

**Cooperation is the key to success.** Although there are lots of players, their interests move them in the same general direction. This project can be a model for collaborative action in other areas.

**Like Rollie Schmitten, I'm not excited about ESA as a management tool** for restoring salmon and steelhead. Litigation produces winners and losers. Negotiation, as exemplified by this project, can achieve a win/win result.

**BPA will allow collected data to drive the decision process.** Sometimes BPA has been accused of analysis paralysis. BPA is a data-driven agency, but it has a bias for action over more studies. If we have it 80% right, we probably have enough information to spend money. Don't let the perfect be the enemy of the good.

## WATER ENHANCEMENT PROJECT

**WALTER LARRICK, Roza Irrigation District**

The Yakima Valley is one of the richest agricultural regions anywhere, but that wealth depends on irrigation. Small irrigation projects began being built in the mid-1800s, and by 1900, all the water in the valley was allocated.

Although the Yakima's watershed produces 3.5 million acre feet of water, only 11% comes during the peak irrigation season, from July to October. The Bureau of Reclamation began building water storage projects in 1903 and finished in the mid-1950s. But water-short years in the 1970s caused allocation disputes. The resulting adjudication process--to decide who the water belongs to--is still not settled and has made the problems of water availability for fish more obvious.

In 1979, Congress authorized the Yakima River Basin Water Enhancement Project. Problems of providing water for irrigation and fish were studied jointly by the state and federal governments. But in 1984, the Yakima project took off on two different tracks. During Phase I, now complete, BPA constructed fish ladders to help fish pass diversion dams and installed screens to divert fish from irrigation canals. However, people couldn't agree on solutions to irrigation problems, and were hesitant to move ahead without knowing the outcome.

Then in 1989, a Round Table involving parties brought together by Washington Congressman Sid Morrison agreed not to try for more big storage projects, but to look at efficiencies in water use first. Phase II legislation, yet to be passed, focuses on reducing water diversions by using structural and nonstructural water conservation measures. The measures would improve instream flows for fish by reducing diversions from the river.

The initial cost to the federal government would be \$100 million, which amounts to one-third of the estimated cost. It would come in the form of a federal grant, not a loan. The other two-thirds of the cost would come from the state and the irrigators. The project would look at the valley as a whole, at total available water supply, at a trust to deal with leased water in water-short years, and at water shortage issues on tributaries. But the concern is to bring the two tracks, water enhancement and fish enhancement, back together again.

## **FISH PASSAGE**

### **ROBERT TUCK, ECO-Northwest** **Fish Passage Overview**

Historically, the Yakima Basin was the second largest salmon and steelhead producing river system in the Columbia River Basin--second only to the Snake River Basin. Before Euro-American development, it had six runs of anadromous fish, including coho and sockeye salmon; steelhead; and spring, summer, and fall chinook salmon.

Irrigation development caused a sharp decline in anadromous fish runs between 1880 and 1920. Diversion dams were built without adult fish ladders, and unscreened canals and ditches routed millions of juvenile salmon and steelhead into fields and orchards. The diversion of water destroyed important spawning and rearing habitat and interrupted migration routes. In addition, storage reservoirs blocked access to spawning and rearing areas.

Early passage facilities, installed between 1905 and 1920, were largely unsuccessful. Those built in the late 1920s and 1930s were only partially effective, due partly to inadequate maintenance.

Although screens were installed in most of the large diversion canals during the 1930s, they had serious design flaws. Installed perpendicular to the water flow, they created water velocities so high that fish could not swim away from the screen and were injured or killed. Inadequate bypass systems trapped fish in canals.

Few improvements were made between 1940 and 1980. Passage effectiveness declined as existing facilities deteriorated from lack of proper maintenance.

Section 900 of the Northwest Power Planning Council's 1982 Fish and Wildlife Program called for construction of fish passage facilities in the Yakima Basin. Phase I, a cooperative effort of many entities in the Basin and the region, was completed in 1990, at a cost of \$55 million. New fish passage facilities are now in place at all major diversion structures. Phase II, currently underway, includes about 60 smaller diversions. They will be completed by 1996, at a cost of \$10-12 million.

The fish passage facilities will significantly help our efforts to restore salmon and steelhead runs in the Basin.

### **R. DENNIS HUDSON, U. S. Bureau of Reclamation** **Engineering**

The Bureau leads a multi-agency Technical Work Group of biologists and engineers to solve fish passage engineering problems. Their goal is to have cost-effective applications of proven technology adapted to specific site characteristics. Although they are not always on the cutting edge of design, on occasion they may be.

Design criteria have been adopted and applied for the major fish passage facilities in the basin. Screens are now installed diagonal to an irrigation canal, rather than perpendicular to the flow, as they were years ago. This alignment creates water velocities low enough that fry can swim away from the screens as they approach. They can then be swept along the screen face to the bypass facilities.

To lower approach velocities, engineers must substantially increase the area of each screen. For example, to reduce velocity from 2.0 to 0.4 feet per second, the screen area must be increased by 500%. Screens are mostly the rotary drum, self cleaning type.

Designs for ladders at dams vary with water conditions. For stable water conditions, weir-and-pool ladders are used; for varying water levels, vertical slot ladders are used.

Many challenges were overcome during construction of the Phase I facilities. Cost estimates tripled, design criteria changed, and construction had to be scheduled between irrigation and flood seasons.

Were we successful? When ladders don't work, fish will try to jump a 15-foot dam. We don't see jumpers anymore.

**DUANE A. NEITZEL, Battelle, Pacific Northwest Laboratory**  
**Evaluation of Screen Facilities**

Battelle's studies assessed the design and operation of rotary drum screens used in the Yakima Basin. Marked fish were released upstream of the screen facilities and then captured as they exited the facility. Nets were also placed in the irrigation ditch downstream from the screen facilities, to determine if fish can pass through or over the screens.

**Are fish descaled, injured or killed as they pass by or through the bypass system?** In 100 tests of over 35,000 fish, including 2,000 native fish, fewer than 2% of the test fish were injured or killed.

**Are screens able to prevent juvenile fish from passing through or over them into the irrigation ditch?** Fish can get past screens through improper seals. After changing the type of seal, fewer than 2% pass through or over the screens when the screen seals are properly installed and maintained.

**Are fish delayed or trapped in screen facilities?** These tests are ongoing. So far, studies show that spring chinook move out in a few hours, but steelhead may hang around for a long time.

**Are predators a problem at screen facilities?** These tests are also ongoing, but so far concentrations have not been found.

**Does water flow change the efficiency of the screens?** Changing water levels don't affect the safe passage of the fish but may delay their migration. We are still working with different flows in an effort to deal with this issue.

*The conclusion is, however, that the screens work.*

**THOMAS A. FLAGG, National Marine Fisheries Service**  
**Cle Elum Lake Sockeye Restoration**

NMFS has been involved in a BPA-funded project to determine if sockeye salmon can recolonize habitat in the Yakima River Basin. Over the past four years, juvenile sockeye salmon from an upper Columbia River stock (Lake Wenatchee) have been reared and released in Cle Elum Lake, in the Yakima River system, to determine if they would survive, migrate to the ocean, and return to release sites.

These studies show that adequate spawning and rearing habitat still exists and that there are no severe blockages to outmigration of sockeye through the Yakima River system. However, fish passage is delayed at Cle Elum Dam. In 1992, a floating surface outfall weir and fish trap will be designed and tested. It would be attached to one of the dam's discharge spillway gates to see if it more efficiently attracts and passes fish than existing structures.

In 1991, a few adult sockeye returned to the basin for the first time in over 60 years. More are expected in the future. This research may provide a key for re-establishing these runs.

## **HABITAT ENHANCEMENT**

### **BRUCE WATSON, Yakima Indian Nation Habitat Overview**

Initial studies indicate that it is rearing habitat, not spawning habitat, that limits fisheries resource enhancement in the Yakima Basin. To diagnose where the problems are and how to solve them, a clinical analogy might be helpful.

First, the "patient." There are six phases in the freshwater life history of Upper Yakima spring chinook: spawning, incubation, emergence, first year growth, overwintering, and smolt outmigration. Each phase has different environmental requirements and occurs in different parts of a subbasin.

A historical template of the spring chinook would show five types of juvenile life history in the basin:

- Type I: Spawns, rears, and outmigrates into upper tributaries of the Yakima and stays there.
- Type II: At an early age of rearing, moves down the Yakima canyon to Roza or Ellensburg.
- Type III: Spawns in the Yakima mainstem, overwinters in Yakima Canyon, and leaves as a one-year-old.
- Type IV: Rears in lower tributaries.
- Type V: Spawns and completes the cycle through summer rearing at any point, but winters in the Toppenish area.

The dominant types are now III and V. There are no Type IV fish, and few Type I and II.

Treatment for these "patients" includes proposed or ongoing habitat projects that address all life phases and Types in the basin. For example, six acclimation ponds proposed in the upper basin will help Types I and II; nine proposed acclimation ponds on the mainstem Yakima would increase Type III production. We most need to improve passage in the upper basin. Riparian restoration, which may be implemented as part of the Yakima Basin Enhancement Project, could also help.

### **WILLIAM BRADLEY, Yakima Indian Nation Ecosystem Approach**

There has been a lack of logic in planning for fish and wildlife. To date, in salmonid protection, wildlife and fish have been separated to different planets. We need instead an ecosystem approach to planning for enhancement.

The Yakima Basin is the only place in the world where a large regional effort is being planned. Although anadromous fish are of prime importance, the Northwest Power Act also requires wildlife mitigation--yet we still don't have any operating wildlife projects in the Yakima Basin. We need to recognize that projects to benefit fish, such as enhancing the riparian zone, can also benefit wildlife if properly planned by an interdisciplinary group. In every habitat project, we need to include wildlife expertise.

The Yakima Indian Nation's work is all done by an interdisciplinary team, from the beginning of planning through implementation. As a result, we have some of the best-kept riparian corridors anywhere. In the Toppenish corridor, wildlife is integrated with the fish restoration effort.

A Soil Conservation Service riparian enhancement effort in the Tucannon River Basin provides a good model as well. Their team includes the county, the school board, and the agency, though it will be even better when they bring in the fish folks.

## YAKIMA FISHERIES PROJECT

### ROY SAMPSEL, Sampsel Consulting Services Goals and Objectives

The Yakima Fisheries Project is based on supplementation, which proposes to enhance natural production of existing stocks while preserving their basic character, adaptability, and fitness. At the same time, ecological and genetic impacts on non-target populations must be kept within specific limits. The best-adapted stocks will be introduced in cases where the species is no longer present. The Project endorses adaptive management and the need to monitor and evaluate the project so that new information is incorporated into its operations.

The success of supplementation will be measured in four areas of performance:

- post-release survival,
- reproductive success,
- long-term fitness, and
- ecological interactions.

The project works with steelhead trout, coho and sockeye salmon, and spring, summer, and fall chinook. A major element is conserving the genetic characteristics currently found in the natural populations in the basin. Six of the more important strategies to minimize adverse genetic impacts on natural populations are:

- Identify and separately culture distinct substocks to be outplanted only in ancestral drainages.
- Mark all hatchery juveniles and use only unmarked adults as broodstock.
- Collect no more than 20% of the return of a given stock for broodstock.
- Use mating schemes that maximize genetic diversity of offspring.
- Attempt to make the hatchery environment more like the natural environment.
- Monitor the same stocks in both supplemented streams and unsupplemented control streams, to compare trends in abundance and genetic indices.

### LARS MOBRAND, Mobrand Biometrics, Inc. Quality Control

The YFP's adaptive management policy imposes special requirements on project planning, operation, and facility design. During planning, by using analysis and computer simulation, we establish a plausible set of conditions under which we can increase production in the Yakima Basin through supplementation.

Once a set of such scenarios has been described, we select some for implementation and develop the experimental designs and monitoring programs needed to test the inherent assumptions. This planning process must integrate genetics, population dynamics, ecology, and general fish biology. To do this, the YFP has been organized around a set of scientific task teams, who develop the experimental plan to be implemented once the project is fully operational. The process provides for peer review to ensure both the quality of the plan and its coordination with engineers and hatchery operations specialists.

One of the challenges of the YFP is to address the need for large sample sizes to ensure reliable experimental results on one hand, while maintaining flexibility to modify the program in response to new information on the other. During the pre-facility phase of the YFP, the science teams approach this challenge by identifying in detail the range of strategies and experimental designs that the facilities must accommodate.

**JIM LICHATOWICH, Alder Fork Consulting**  
**Regional Assessment of Supplementation Project (RASP)**

In 1841 in France, two commercial anglers stood on a streambank watching salmon spawn. They jury-rigged a contraption to take eggs out of the river--to prevent wasting the eggs. That was the beginning of hatchery production of fish.

Hatchery production didn't live up to expectations because it didn't fit into the ecosystem. Supplementation has brought us full circle, back to the streambank.

Supplementation requires quality habitat. If that is available, supplementation will account for 52% of the increase in Columbia River Basin fish production.

RASP has three objectives:

- **Describe the supplementation program.** It provided the definition of supplementation used by the Yakima Fisheries Project and the list of performance standards for supplementation projects described by Roy Sampsel.

- **Develop analytical tools.** These include supplementation theory; a conceptual model of how hatchery fish are introduced into the natural cycle; a spreadsheet model to help evaluate costs and benefits; classification research; and a monitoring and evaluation plan for the region.

- **Provide specific program and project advice.** RASP has provided a sequence of planning steps, advice on how to maximize the power of research tests, and advice on how to make decisions in the midst of uncertainty.

**CRAIG BUSACK, Washington Department of Fisheries**  
**Genetic Risk**

Recent years have seen increasing acceptance of the concept that good management of salmonids requires management not only of their numbers, but also of the genetic resources they represent. A vital part of this management is assessment of genetic risks of proposed management actions. The Yakima Fisheries Project was the first production project in the Columbia Basin, and perhaps the first hatchery project anywhere, to conduct a genetic risk assessment.

We have identified four categories of genetic risk.

- 1) **Extinction.** Its consequences are obvious: if a population becomes extinct, all its genetic material is lost to the species and to us as managers.

- 2) **Loss of within-population genetic diversity.** This is usually caused by small effective population size. The ability of a population to respond genetically to changing environmental conditions is directly related to its genetic diversity.

- 3) **Loss of between-population diversity.** Caused by interbreeding between populations, it is important because genetic differences between populations likely represent unique adaptive gene complexes.

- 4) **Domestication selection.** This concept--the way cultured populations adapt to the hatchery environment--is quite controversial. It is widely perceived in the region that hatcheries may be developing fish that are genetically handicapped for life in the wild; however, at this point it is unclear how important this effect is.

Genetic risk assessment in the YFP is an iterative process. Our original assessment was done without benefit of substock identification research or guidelines for assessing risk. Now guidelines and the results of three years of genetic research enable us to substantially revise the risk assessment in 1992.

**ROBERT GATTON, CH2M Hill**

**ROBERT HAGER, Consultant to Washington Department of Wildlife  
Engineering Design/Production Program Overview**

The artificial production goal of the Yakima Fisheries Project is to produce high quality smolts in the required number and at the required locations to meet the objectives of supplementation within the guidelines of the experimental design. The engineering designs are driven by the science--the biological needs of the fish--and the research goals of the program.

In numbers, this goal translates to the annual production of 8.3 million juvenile salmon and steelhead weighing a total of 437,300 pounds. To do this, the following facilities are needed:

- **3 central facilities** at Cle Elum, Nelson Springs, and Oak Flats. Cle Elum will produce spring chinook and summer steelhead; Oak Flats will produce spring and summer chinook, summer steelhead, and coho; and Nelson Springs will produce Naches summer steelhead and Yakima fall chinook.

- **30 acclimation sites.** 18 are associated with Cle Elum, grouped, for research purposes, in threes; the rest are associated with Nelson Springs and Oak Flats, grouped in pairs.

- **2 satellite facilities** on the lower river.

- **3 adult and 3 juvenile traps** for collecting broodstock and for monitoring the success of the program.

**The map shows facility locations in the basin.**

The project has several unique aspects:

- offsite collection of broodstock;
- upwelling water supply in broodstock holding ponds;
- overhead sprinklers on broodstock holding ponds;
- well water for incubation or for rearing.

**The project poses substantial water supply challenges.** The facilities will need a total of 40 million gallons of surface water and 30 million gallons of groundwater each day--enough to supply a city of a million people. All sites have adequate surface water, but groundwater at sites such as Oak Flats is harder to get and will require more wells than originally expected. Acclimation sites all use surface water only. At hatcheries, ground water will be used for summer rearing when surface water is too warm and will always be used for incubation--the cooler water slows the incubation period and more closely approximates natural conditions.

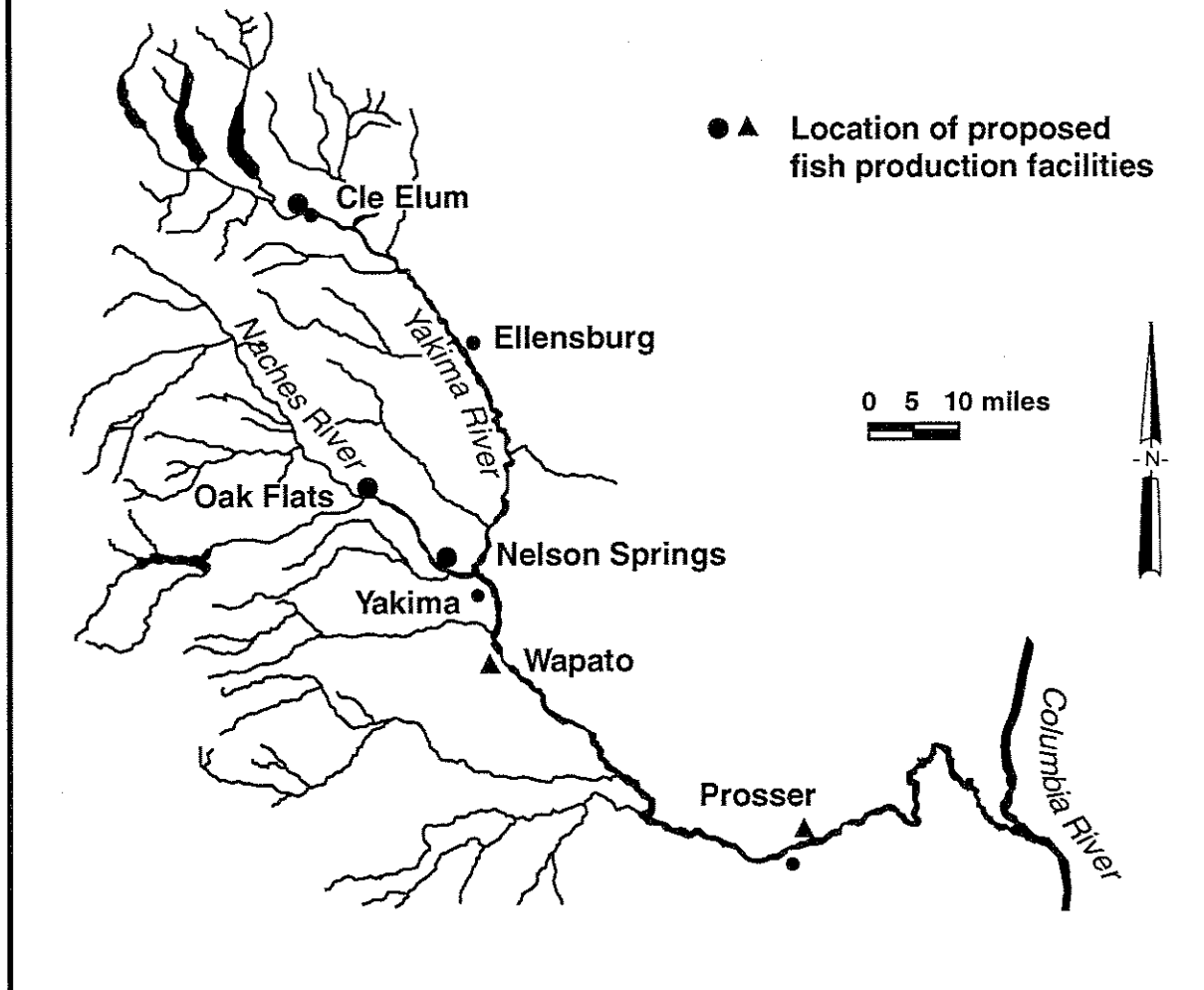
**Rearing vessels are designed differently than usual.** Vessels were sized for experimental groups, and designed with enough flexibility for future unknown experiments. Fish densities will be light--half the level of traditional facilities. Raceways, the main rearing vessels, have been designed so that people are not so much in view of the fish as they are in traditional raceways. Fish will not be fed by hand, for example. Acclimation ponds, also used for rearing, are being developed that will allow stumps, rocks, or other materials to be placed on the bottom, to simulate the natural environment.

**DAVID FAST, Yakima Indian Nation**

**DESMOND J. MAYNARD, National Marine Fisheries Service  
Artificial Environment/Treatment Selection**

The Artificial Environment/Treatment Selection Task Team must 1) develop a hatchery-reared fish that will survive at a high rate and return to spawn successfully in the natural stream in which it was released, and 2) develop the hypotheses and treatments to test how well supplementation enhances the natural production of salmonids.

## Yakima River Subbasin



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By rearing salmon in a hatchery environment, we can increase their survival during egg incubation and early rearing. Once released into the natural environment, however, these hatchery fish have a lower survival rate than wild fish, possibly because they have not learned to forage for natural food or to avoid predators.

We are trying different strategies, at all stages from spawning to release, to see whether hatchery fish can be made more like wild fish. Some of the strategies are:

- **Broodstock** will be collected from returning wild adults, not hatchery fish, as is usual.
- **Mating strategies** will be designed to minimize loss of genetic variability.
- During **incubation**, water will be maintained at temperatures similar to the part of the stream from which the fish would normally have come. Material will also be placed in raceways and ponds to help the fish learn how to use cover.
- **Rearing** is the period when fish are most susceptible to becoming stupid. In traditional hatcheries, they are being fed rather than learning to feed. They need to learn how to use cover, how to find food in the wild, and how to avoid predators.
- In the Yakima project, **raceways** are designed to eliminate people close by. In the usual raceway, fish learn to swim toward the surface to large dark shadows approaching, because the shadow means someone is coming with food. In the natural environment, a large dark shadow above them is likely to be a predator—not something they should be swimming *toward*. The team will be looking at a **food delivery system** that avoids having humans around.
- They will also be looking at culturing **natural food** to replace the traditional pellets and studying the effectiveness of live food diets. Live foods give the fish more natural color and improve their ability to forage.
- Different natural elements were tried on **raceway bottoms**. Fish would feed off sand or a barren bottom, but not off gravel. The sand did not create extra maintenance or cleaning problems.
- **Lower light levels and higher raceway structures** also lowered aggression.
- In **acclimation** ponds, the fish will become accustomed to the water to which researchers hope they will return. The ponds should also reduce transportation stress and interactions with resident or wild fish. At Cle Elum, three ponds per site allow two treatment and one control pond for experiments.
- **Volitional release** will be used to release fish when they are ready to leave rearing areas. Letting them go when they feel like it minimizes interactions with other fish, and helps researchers determine the best age and time for release.

## LEE HARRELL, National Marine Fisheries Service Fish Health

In the spring of 1991, NMFS began a program to define existing fish diseases among salmonids in the Yakima Basin, and to plan for disease prevention and control at artificial propagation facilities. The project was designed to predict how wild fish diseases might affect the progeny of wild salmonids reared in hatcheries.

We examined yearling chinook and steelhead migrants and post-spawned fall chinook from the Yakima River. In addition, using fish in live-boxes, we looked for diseases that could be contracted at proposed rearing and supplementation sites.

### Findings:

- A relatively low prevalence (7.2%) of BKD in wild chinook salmon and steelhead. The rate for some chinook hatcheries may approach 50 - 60%.
- 36% of yearling salmonids were infected with an ectoparasite (*Neascus* sp.-- "black spot"), which is thought not to affect general fish health.

- 61% of post-spawned fall chinook were infected with *Ceratomyxa shasta*, a parasite that could adversely affect juvenile salmonids. Next year, the live-box studies will be designed to determine if fish can contract *C. shasta* from the Yakima River.

**DENNIS DAUBLE, Battelle, Pacific Northwest Laboratory  
Water Quality Studies, 1988-1991**

We synthesized data from Bureau of Reclamation, U.S. Geological Survey, and our own studies to assess potential constraints to anadromous fish production posed by streamflow and water quality.

**Findings:**

- We found no water quality problems for fish growth and survival at any of the proposed production sites that use surface water.
- There were no concerns with pollutants, such as trace metals. Normal hatchery practices should prevent problems during fish culture activities.
- Fish held until late May were stressed by turbidity and high temperatures, but they normally would not be held that long.
- Next year we will look at well water, incubating eggs in water from four locations to determine the time eggs take to hatch and their hatching success rate.
- Temperatures in the lower river can, at their maximum, be lethal to salmon. So, even if fish do well during rearing, they could have problems during migration to the lower river. Water temperatures could possibly be reduced by increasing flows from the reservoir or decreasing irrigation return flow.

A matrix is being developed that looks at salmonid water quality needs of each species and its location in the basin during each life stage. The matrix is expected to help engineers and planners develop technology and policies that maintain water quality for these fish.

**STEVEN LEIDER, Washington Department of Wildlife  
Natural Environment Task Team**

The Natural Environment Task Team guides the habitat improvement piece of the Yakima Fisheries Project. The team focuses on three main areas:

- **Habitat.** This group classifies and inventories habitat; develops options for managing and accessing data; and identifies short- and long-term opportunities for habitat enhancement.
- **Natural Productivity.** Beginning with the subbasin plan, this group analyzes limiting factors for natural fish production, and it models carrying capacity.
- **Ecosystem Dynamics.** This group looks at interactions between target and non-target species and habitat and models community ecology.

The goal is to move from a single species viewpoint, and instead to look broadly at multi-species and environmental indicators of success. In other words, we want to answer the question: When we take action, what is happening to the entire system?

However, it is difficult to ascribe a change in run size to a specific habitat change because fish are affected at all stages in their life cycle by human action or inaction. The system planning model is useful in estimating relative benefits, not absolute numbers.

## **GEOFFREY MCMICHAEL, Washington Department of Wildlife Species Interactions Study**

The Species Interactions Study has three main objectives:

- Collect baseline data on resident trout in the Yakima River and its tributaries upstream of Roza Dam.
- Study the competition between resident trout and the supplemented fishes.
- Develop a long-term monitoring plan that can detect changes in resident trout distribution, age, size, abundance, and genetic character after supplementation with anadromous stocks is begun in about 1996.

### **Findings:**

- **Baseline surveys:** Peak spawning is from late March to mid-April. Densities fluctuated widely, but went down in 1991, possibly due to a flood in late 1990. Genetic sampling identified three separate groups in the study area. In many tributaries, the mixture of species changed as distance upstream increased. Within a given stream, lower elevation areas tend to be dominated by rainbow trout, while the upper elevation areas have more cutthroat trout.

- **Smolt release study:** Aggressive behavior was noted between hatchery and wild fish, especially in the first two weeks after release. About 38% of the hatchery steelhead did not migrate beyond 11 kilometers below the release point, and snorklers observed the non-migrants behaving more like wild fish as time passed. Only 2% of the hatchery fish passed Prosser Dam, on the lower Yakima River.

Experiments will continue through 1995. In 1996, monitoring will begin.

## **BRUCE WATSON, Yakima Indian Nation THOMAS RUEHLE, National Marine Fisheries Service Post-Release Survival**

The Post-Release Survival Task Team studies wild and hatchery smolt survival, including both smolt-to-smolt and smolt-to-adult survival rates; studies the difference between hatchery and wild smolt survival rates; designs and manages all efforts to increase smolt-to-smolt survival; and assesses the adequacy of juvenile and adult observation facilities for monitoring required by other teams.

Studies show that hatchery fish survive at much lower rates than wild fish--sometimes at only 10% of the wild fish rate. If we knew where they were dying, it might help determine why fewer survive and which measures to help them work and which do not.

Studies also show a 70% mortality rate before fish reach the Columbia River--50% are lost between Sunnyside and Prosser dams. We need to determine the location, magnitude, causes, and remedies for areas of high smolt mortality. We also need to ensure that the fishes' reproductive success is not impaired by our monitoring.

To monitor the progress and survival of fish throughout the Yakima system, we need adult and juvenile counting facilities at Prosser. But Prosser can't handle fall chinook because they spawn below the dam, so we're hoping to use Horn Rapids.

Two other areas would provide useful data if methods can be developed. One is the area above Prosser, to estimate smolt-to-smolt survival, by substock and life history type. However, we don't yet know how to do this. The other area is below Prosser. We hope to use PIT-tagged fish to estimate numbers of fish diverted into the canal and their survival; fish survival through Prosser Dam's forebay; and survival of spilled fish.

The Chandler Canal is the main diversion canal on the Yakima system. More than 50% of the river's water is diverted into the canal, so a lot of fish--60 to 90%--go that way.

Chandler has two PIT-tag detectors. A PIT tag is a transponder the size of a grain of rice that is implanted into a fish. Fish in the canal are diverted into a system of pipes that eventually lead them past a "black box," where an electrical stimulus identifies each fish as an individual, without handling the fish. The PIT tag can tell us when the fish came through the facility and the type of fish that came--did Pond A fish come before or after Pond B fish? It allows us to compare survival between species and among the experimental treatment types that will be part of the supplementation research.

In 1991, we estimated 100% survival of fish that either went through Prosser's forebay or were spilled, but only about 90% survival for fish that went through Chandler canal. The Chandler facility is a tool to help us determine the reasons for the difference.

### **CURTIS KNUDSEN, Washington Department of Fisheries Reproductive Success**

The Reproductive Success Task Team measures and compares the reproductive success of first generation supplemented (hatchery-reared) and wild (naturally reared) fish spawning in the natural environment. (The Long-Term Fitness Task Team studies productivity over many generations.) The extent to which first-generation hatchery fish contribute to natural production will be a major factor in determining the overall success of the Yakima Fisheries Project.

By "reproductive success" we mean the number of progeny or returning adults that each spawner produces. We will compare the reproductive success of hatchery and natural fish (during pre-spawning and spawning) and of the offspring of their subsequent matings (during incubation, juvenile rearing, and smolt-to-adult periods). Then inferences can be made about critical periods and influences experienced by supplemented and wild fish. The comparisons should help determine the influence genetic factors have on reproductive success.

### **WILLIAM HOPLEY, Washington Department of Fisheries Adult Monitoring**

Data for monitoring YFP's overall success and the biological response variables of reproductive success, long-term fitness, habitat, and post-release survival depend on our ability to track returning adults. We need to determine such things as run timing and duration, total numbers returning, and individual age, length, and origin.

We can monitor intrusively, by physically handling each fish to measure it, remove scales, sample tissue, or inspect it for tags; or by removing it for broodstock. Or we can monitor passively, by visual inspection, video cameras, or electronically with PIT tags.

During the pre-facility design phase, monitoring has been conducted primarily at Prosser and Roza Dams for spring chinook salmon and steelhead. During the 1991 adult season, monitoring was expanded to include fall chinook salmon at Horn Rapids Dam and small fish passage facilities in Marion Drain and Toppenish Creek.

For the post-production phase, we currently expect to need monitoring at Roza, Prosser, Cowiche, and Horn Rapids dams; at Marion Drain; at Toppenish, Satus, and Cowiche creeks; and at American River.

## **CRAIG BUSACK, Washington Department of Fisheries Long-Term Fitness**

The Long-Term Fitness Task Team oversees all research and planning related to genetics for the Yakima Fisheries Project. Its philosophy is to protect a population's long-term fitness rather than to preserve individual genetic characteristics.

Management of genetic resources requires a good understanding of the resources that exist. Therefore, a key element of the LTF team's work is to oversee and apply results from substock identification research. Since the effort's beginnings in 1989, substantial progress has been made on spring and fall chinook salmon, steelhead, and rainbow trout.

Planning for protection of the Basin's salmonid genetic resources occupies most of the LTF team's time. The team is:

- 1) updating the fisheries project's risk assessment;
- 2) developing genetic hatchery guidelines; and
- 3) developing a genetic monitoring program.

Risks are based on the substocks present, their genetic condition, and the intended management activities. Risks will be limited largely through hatchery management practices, and success in limiting risk will be assessed by monitoring genetic impacts.

In 1992, the team will produce review draft documents in each of the three areas. They will address both general issues and YFP specifics, as did the 1990 genetic risk assessment (now available). They should be useful as models for other programs in the Basin and elsewhere.

## **LOWELL STUEHRENBURG, National Marine Fisheries Service Radio-Telemetry Studies**

The radio-telemetry tag is 3/4 inch in diameter and 2 inches long, placed in the fish's gut. At several sites along the river, antennae in the air and under water detect the fish as they pass. Radio-telemetry studies target adult wild spring chinook salmon and steelhead. They look at:

- when substocks pass broodstock collection sites;
- migration behavior to determine holding or staging areas;
- spawning locations and timing; and
- adult passage and collection facilities to evaluate them for separation of substocks.

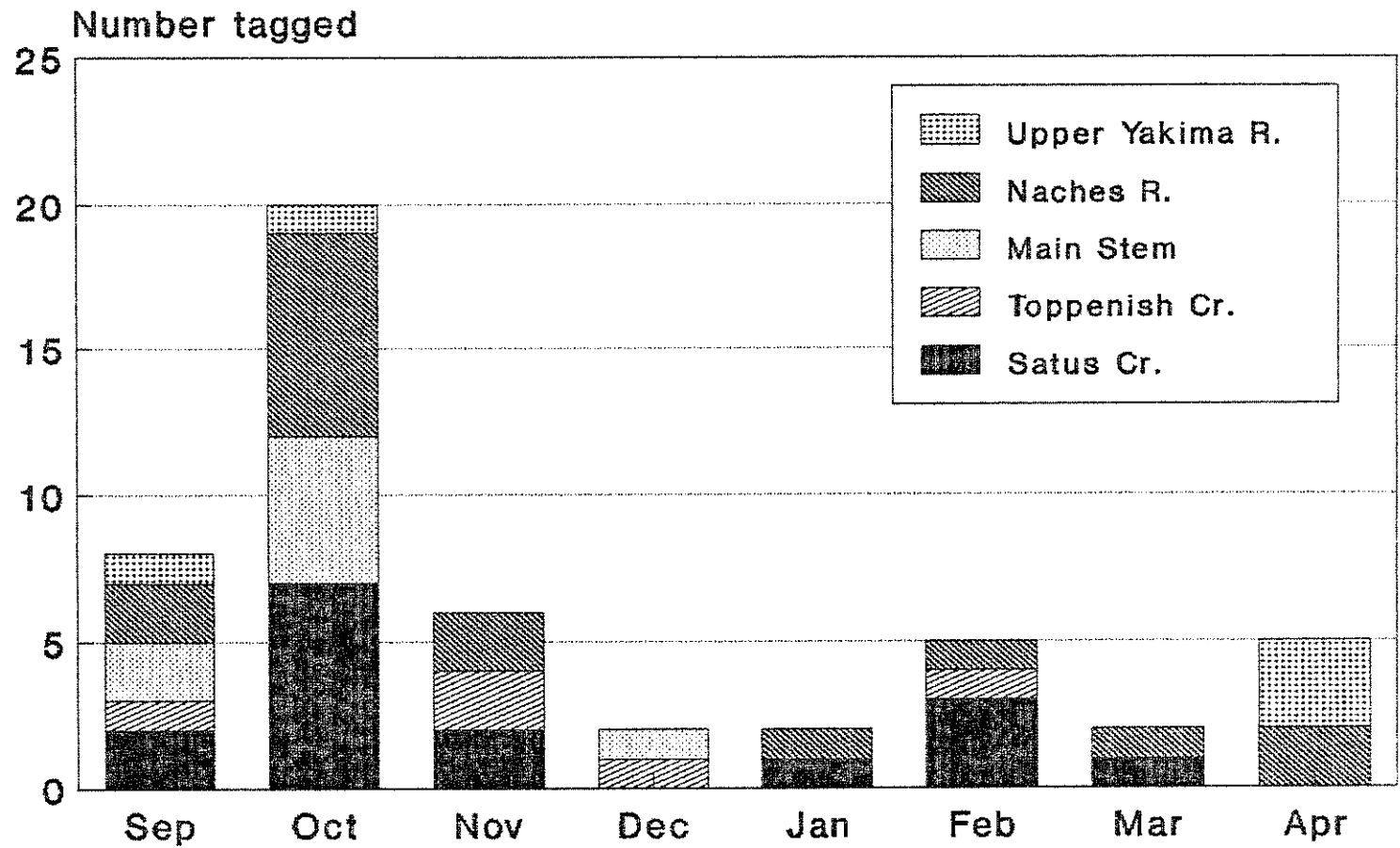
Sample findings for steelhead and spring chinook are shown in the accompanying graphs.

The studies also showed that many steelhead and some chinook tried to jump Cowiche Dam; few chinook used the ladder. (However, this conclusion is based on a sample of only 16 fish.) At Roza Dam, fish tend to avoid the right bank ladder or are attracted to the left bank for structure or flow reasons, it's not clear which. Prosser also has passage problems through the right bank ladder, but it is unclear whether the problem is the type of ladder or that flow is controlling where the fish pass.

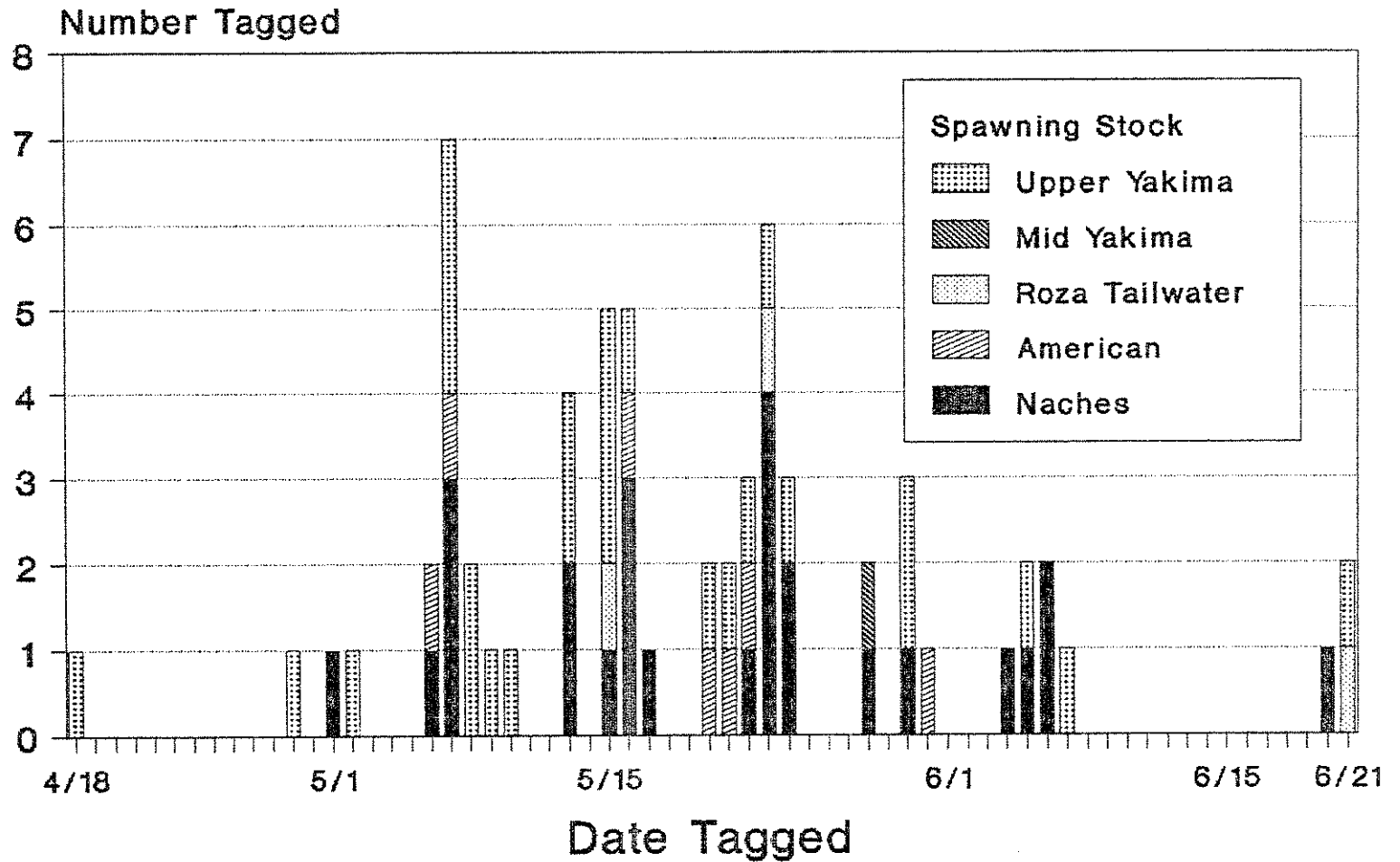
Future studies will look at passage, at straying above Roza, and whether hatchery fish migration behavior is similar to that of wild fish.

# STEELHEAD RUN TIMING

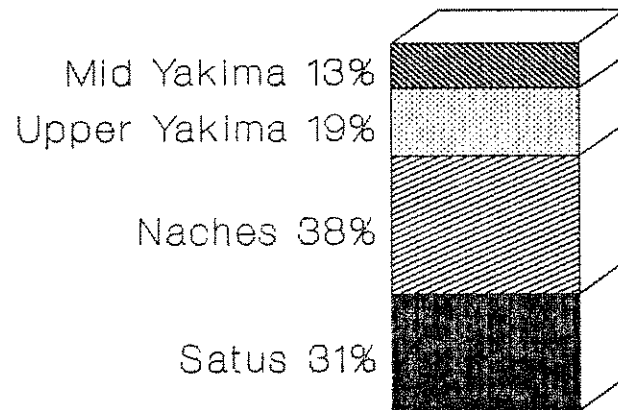
## PROSSER DAM - 1989-91



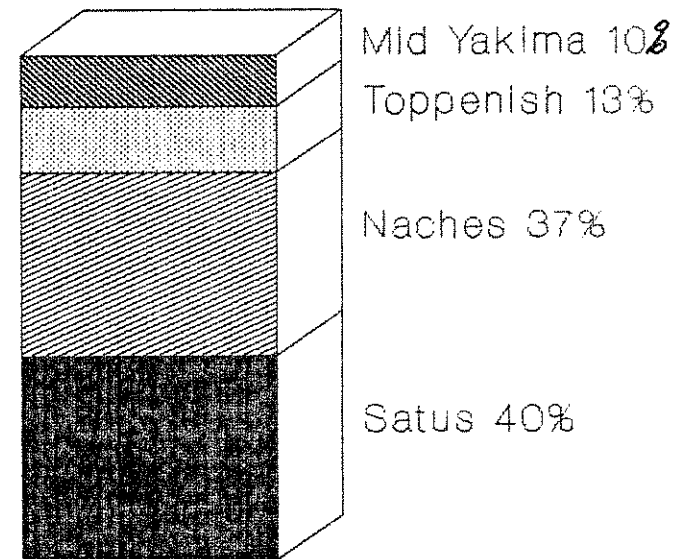
# CHINOOK RUN TIMING PROSSER DAM - 1991



# SPAWNING DISTRIBUTION STEELHEAD



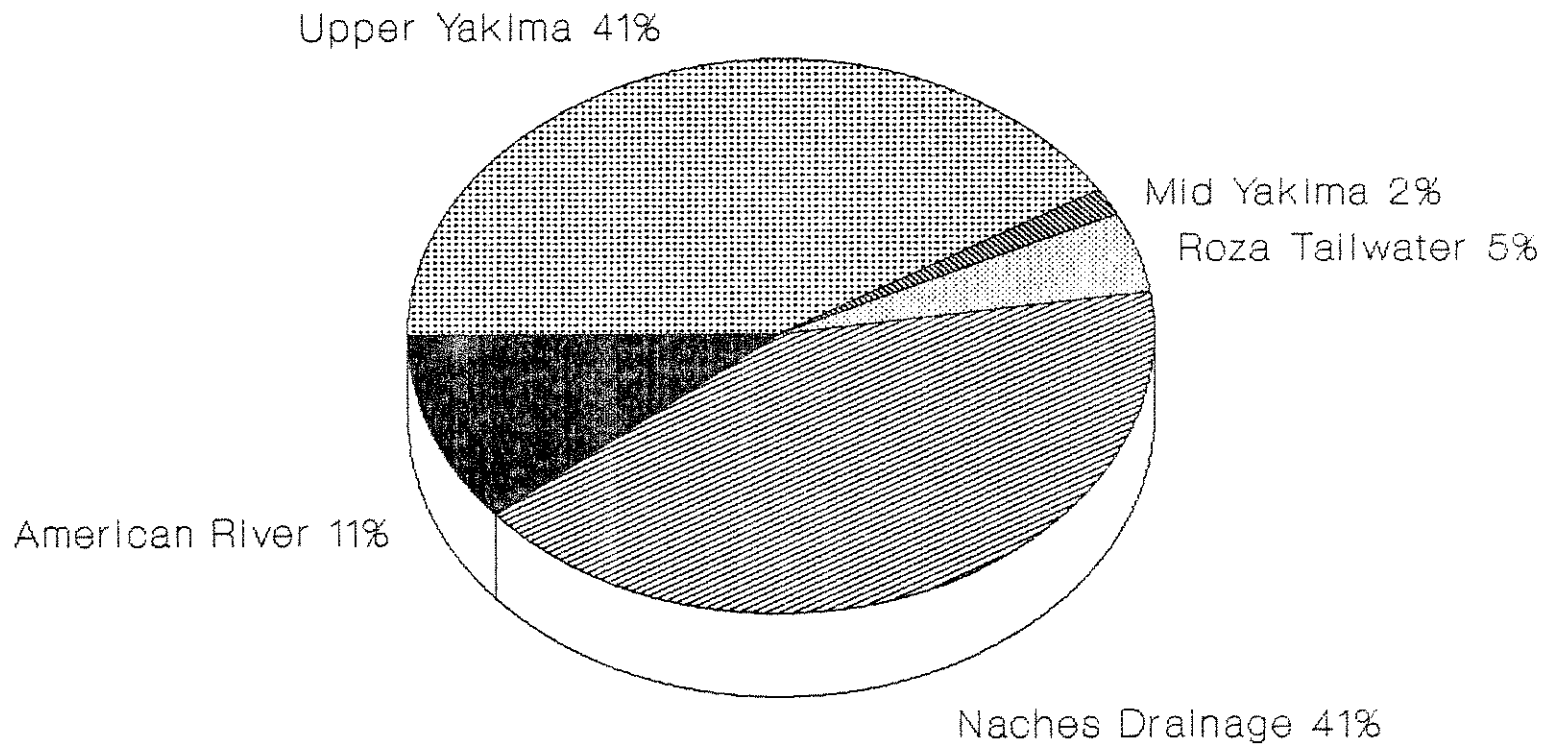
1990  
N = 16



1991  
N = 30

# SPAWNING DISTRIBUTION

## Spring Chinook 1991



N = 63

# PASSAGE AT COWICHE DAM

## SPRING CHINOOK 1991

